REMARKS/ARGUMENTS

Reconsideration is respectfully requested.

Claims 1-10 are pending in the present application before this amendment. By the present amendment, claim 4 and 9-10 have been cancelled without prejudice, and claim 1 has been amended. No new matter has been added.

In the Office Action, claim 1 stands objected to for containing minor informalities. Appropriate correction has been made, and withdrawal of the objection is respectfully requested.

Also in the Office Action, claims 1-2, 5, and 9-10 stand rejected under 35 U.S.C. § 103(a) as being obvious over U.S. Patent Application Publication No. 2004/0113235 (Coolbaugh). The "et al." suffix, which may appear after a reference name, is omitted in this paper.

The presently claimed invention is directed to a very novel process of forming a four layer capacitor structure of, for example, a copper layer 300 and the layer 400 of TaN, Ta, Ti, TiN, or Ru, together forming the lower electrode, a dielectric layer 450 formed by oxidizing the layer 400, and the upper electrode layer 500 of TaN, Ta, Ti, TiN, or Ru. The layers 400, 450, and 500 are formed in-situ in one equipment.

This is a significant improvement of the prior art techniques. As described in the Specification page 8, lines 10-20:

(1) Manufacturing cost is reduced compared to prior art, because deposition equipment for depositing dielectric material is not needed.

(2) Process time is remarkably reduced compared to prior art, because formation of the lower electrode layer, the dielectric layer, and the upper electrode layer

is performed in-situ in one equipment.

(3) Contamination due to substrate movements for deposition of dielectric materials is reduced compared to prior art, because the oxidation process is carried out in-situ in on one piece of equipment.

Claim 1 has been amended to recite this novel aspect of the present invention, namely:

> --iv) forming a capacitor lower electrode layer after forming a second barrier layer and a third barrier layer **by depositing one of TaN, Ta, Ti, TiN, and Ru** on the metal layer;
>
> v) forming a dielectric layer by oxidizing the capacitor lower electrode layer;
>
> vi) forming a capacitor upper electrode layer **by depositing one of TaN, Ta, Ti, TiN, and Ru** on the dielectric layer**, wherein the capacitor lower electrode layer, the dielectric layer, and the upper electrode are formed in-situ without equipment change**;--

The support for the above amendment is found at least in the Specification page 7, lines 10-19 of the present application.

Coolbaugh does not teach or suggest, inter alia, the above claim 1 as amended.

Coolbaugh as clearly depicted in FIG. 5F teaches a capacitor 100 having a pedestal 40 formed on the copper lower electrode 18 to increase capacitance. The structure of the capacitor as taught by Coolbaugh is a six-layer structure/procedure that requires some equipment change between the processes.

That is, Coolbaugh teaches forming the capacitor 100 (see FIG. 5F) by:

(1) electroplating the copper lower electrode 18 having the pedestal 40;

(2) depositing the barrier layer 50 preferably of tungsten to cover up the exposed pedestal 40;

(3) deposing a precursor layer 60, preferably of TaN;

(4) anodic oxidation of the precursor layer 60 to form the dielectric layer 62;

(5) depositing a seed layer of Ta/TaN/Cu on the dielectric layer 62; and

(6) electroplating the copper upper electrode layer 66.

The resulting structure of the Coolbaugh's capacitor 100 is at least a five-layer structure (copper lower electrode, tungsten barrier metal; dielectric layer; a seed layer; and a copper upper electrode), and this is quite different from the four layer capacitor structure of the presently claimed invention in terms of both the structure and process as shown in FIG. 12 (the copper metal layer 300; the lower electrode layer 400; the dielectric layer 450a; and the upper electrode layer 500).

Coolbaugh requires the barrier layer 50 preferably of tungsten because of the pedestal 40 that is the central subject matter of the Coolbaugh's invention taught and disclosed. According to the presently claimed invention, no such barrier layer is required to separate any portion of the lower electrode and the dielectric layer.

Further, the claimed upper electrode 500 is not copper, unlike Coolbaugh which teaches the copper electrode 66. Rather, the claimed upper electrode 500 is one of the same materials TaN, Ta, Ti, TiN, and Ru that can be selected to form the lower electrode layer 400. This selection of material for the claimed upper electrode 500 that is not copper is quite different from Coolbaugh and provides significant advantage over Coolbaugh in a way that the formation of the layers 400, 450, and 500 is completed in-situ without change of equipment. This in-situ is possible partly because the material for the upper electrode 500 is selected from one of those materials that are available for selection in forming the lower electrode layer 400.

Coolbaugh fails to teach or suggest this. In order to form the capacitor 100, Coolbaugh teaches three different processes of (1) deposition of various seed layers, (2) electroplating process of the seed layer to form a copper metal layer, and (3) anodic oxidation process, and carrying out the all of which processes would require at least one equipment change.

Thus, the claimed structure of the MIM capacitor as made by the processes of the amended claim 1 is quite substantially different from Coolbaugh, and further the claimed in-situ process forming the claimed lower electrode layer, the dielectric layer, and upper electrode layer is not taught or suggested by Coolbaugh. Furthermore, Claim 1 as amended is still not taught or suggested even if Narwankar is considered in combination with Coolbaugh.

For the reasons set forth above, Applicant respectfully submits that claims 1-3 and 5-8, now pending in this application, are in condition for allowance over the cited references. This amendment is considered to be responsive to all points raised in the Office Action. Accordingly, Applicant respectfully requests reconsideration and withdrawal of the outstanding rejections and earnestly solicits an indication of allowable subject matter.

Should the Examiner have any remaining questions or concerns, the Examiner is encouraged to contact the undersigned attorney by telephone to expeditiously resolve such concerns.

Respectfully submitted,

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